

IN THE DRAWINGS

The attached sheet of drawings includes changes to Figs. 2 and 3. These sheets, which include Figs. 2 and 3, replace the original sheets including Figs. 2 and 3.

Attachment: Replacement Sheet (2)

REMARKS/ARGUMENTS

Favorable consideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 5-20 are presently pending in this application, Claims 5-15 having been amended and Claims 16-20 having been newly added by the present amendment.

In the outstanding Office Action, the title of the application was objected to for not being descriptive; the drawings were objected to because of informalities; the specification was objected to for informalities; Claims 5-15 were rejected under 35 U.S.C. §112, second paragraph, for being indefinite; Claims 5-7, 9, 10, 13 and 14 were rejected under 35 U.S.C. §102(b) as being anticipated by either one of GB 2167738 A (hereinafter "GB '738") or JP 2004-161225 (hereinafter "JP '225"); Claims 5-7, 9, 10, 13 and 14 were rejected under 35 U.S.C. §102(b) as being anticipated by Fujii et al. (U.S. Patent 5,318,758); and Claims 8, 11, 12 and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over any one of GB '738, JP '225 or Fujii et al. in view of Thonsgaard (U.S. Patent 6,183,540).

In response to the objection to the title of the present application, a new title for the subject invention has been submitted herewith. The new title is believed to be fully descriptive of the present invention and no further objection to the title is therefore anticipated.

Regarding the objection to the drawings, submitted herewith is a separate LETTER SUBMITTING REPLACEMENT DRAWING SHEET(S), submitting for approval changes to Figures 2 and 3. Specifically, Figures 2 and 3 have been designated by a legend "Prior Art" as required by the Examiner.

Also, the specification has been amended to insert a cross-reference to a related application and to modify the abstract of the disclosure.

With regard to the rejection under 35 U.S.C. §112, second paragraph, Claims 5-15 have been amended to clarify the subject matter recited therein. Thus, Claims 5-15 are believed to be in compliance with the requirements of the statute. Also, amended Claims 5-15 and newly added Claims 16-20 are believed to be fully supported by the original disclosure of the present application. If, however, the Examiner disagrees, the Examiner is invited to telephone the undersigned who will be happy to work in a joint effort to derive mutually satisfactory claim language.

Briefly recapitulating, Claim 5 as currently amended is directed to an amine recovery apparatus including a carbon dioxide absorption section and plural water washing sections. The carbon dioxide absorption section brings the exhaust gas into vapor-liquid contact with an absorbing solution containing an amine compound and produces decarbonated exhaust gas. The water washing sections bring the decarbonated exhaust gas into vapor-liquid contact with washing water and sequentially recover the amine compound accompanying the decarbonated exhaust gas, while the decarbonated exhaust gas passes through the water washing sections in sequence from inlet portions to outlet portions thereof, respectively. The water washing sections have plural liquid reservoirs provided at the inlet portions of the water washing sections, respectively, and the liquid reservoirs reserve the washing water which is transported to the outlet portions of the water washing sections and supplied to the water washing sections, respectively. By providing such plural water washing sections, the amine recovery apparatus recovers the amine compound from the decarbonated exhaust gas in the water washing sections more effectively. Specifically, the water washing sections can provide separate stages for recovering the amine compound in the decarbonated exhaust gas. The water washing section in each stage has the liquid reservoir installed on its inlet side, and the washing water is transported from the liquid reservoir to the outlet side of the water washing section, and supplied to the water washing section. Since the water washing sections

are installed in the plural stages and separated from each other, the amine compound in the decarbonated exhaust gas can be roughly collected in the preceding-stage water washing section which is located upstream in the flowing direction of the decarbonated exhaust gas, and finish-recovery of the amine compound can be carried out in the succeeding-stage water washing section which is located downstream in the flowing direction of the decarbonated exhaust gas. That is, the apparatus of Claim 5 can roughly collect the amine compound in the preceding-stage water washing section separated from another water washing section to minimize the amount of the amine compound flowing into the succeeding-stage water washing section, thereby keeping the concentration of the amine compound in washing water in the succeeding-stage water washing section at a low level. Since the washing water has such a low amine compound concentration, the water washing section can recover the amine compound in a vapor state until its concentration becomes minimal.

GB '738 and JP '225 are related to a device for removing hydrogen sulphide from gaseous mixtures and a device for removing CO₂ from combustion exhaust gas, respectively. However, both GB '738 and JP '225 fail to teach or suggest "a plurality of water washing sections configured to bring the decarbonated exhaust gas into vapor-liquid contact with washing water and sequentially recover the amine compound accompanying the decarbonated exhaust gas, while the decarbonated exhaust gas passes through the water washing sections in sequence from inlet portions to outlet portions thereof, respectively, wherein the water washing sections have liquid reservoirs provided at the inlet portions, respectively, and the liquid reservoirs reserve the washing water which is transported to the outlet portions of the water washing sections and supplied to the water washing sections, respectively" as recited in amended Claim 5. Specifically, GB '738 merely discusses a device including an absorber 2 and a single regeneration column 8, and JP '225 simply shows a device having a CO₂ removing tower 1, and none of these devices includes plural water washing sections which

have liquid reservoirs provided at their inlet portions, respectively. Therefore, the apparatus of Claim 5 is believed to be clearly distinguishable from GB '738 and JP '225.

Fujii et al. and Thonsgaard describe an apparatus for removing CO₂ from combustion exhaust gas, and a device for extracting aromatic hydrocarbons. Nevertheless, neither Fujii et al. nor Thonsgaard teach or suggest "a plurality of water washing sections configured to bring the decarbonated exhaust gas into vapor-liquid contact with washing water and sequentially recover the amine compound accompanying the decarbonated exhaust gas, while the decarbonated exhaust gas passes through the water washing sections in sequence from inlet portions to outlet portions thereof, respectively, wherein the water washing sections have liquid reservoirs provided at the inlet portions, respectively, and the liquid reservoirs reserve the washing water which is transported to the outlet portions of the water washing sections and supplied to the water washing sections, respectively" as recited in amended Claim 5. Specifically, Fujii et al. shows in Fig. 3 an apparatus having a CO₂-removing tower 1 including a lower contact section 2 and an upper contact section 3. In this apparatus, the MEA solution is simply stored at the bottom of the tower 1, and the liquid reservoirs are not provided for each of the contact sections 2, 3. Furthermore, Thonsgaard discusses a device for removing aromatic hydrocarbons from a gas stream and only illustrates in Fig. 2 a vessel including a mist extractor 80. Therefore, the structure recited in Claim 5 is believed to be clearly distinguishable from Fujii et al. and Thonsgaard.

Because none of GB '738, JP '225, Fujii et al. and Thonsgaard discloses the plurality of water washing sections as recited in Claim 5, even the combined teachings of these cited references are not believed to render the structure recited in Claim 5 obvious.

For the foregoing reasons, Claim 5 is believed to be allowable. Furthermore, since Claims 6-20 ultimately depend from Claim 5, substantially the same arguments set forth

above also apply to these dependent claims. Hence, Claims 6-20 are believed to be allowable as well.

Applicants also wish to point out that Claims 6 and 17 recite that “one of the water washing sections is supplied with regeneration tower refluxed water mixed with the washing water transported from one of the liquid reservoirs to the outlet portion of the one of the water washing sections.” As such, the concentration of the amine compound in the washing water can be decreased, and thus the recovery amount of the amine compound is further increased, thereby decreasing the amine compound in the decarbonated exhaust gas up to a minimum concentration. On the other hand, none of GB ‘738, JP ‘225, Fujii et al. and Thonsgaard is believed to discuss that one of the water washing sections is supplied with regeneration tower refluxed water. Thus, Claims 6 and 17 are believed to be further distinguishable from GB ‘738, JP ‘225, Fujii et al. and Thonsgaard.

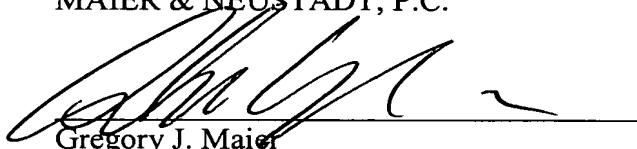
Moreover, Claims 7, 10 and 18 recite that “the water washing sections comprise one in a preceding stage and one in a succeeding stage, and the washing water is withdrawn from the liquid reservoir of the one in the succeeding stage and supplied to the liquid reservoir of the one in the preceding stage.” As such, the concentration of the amine compound in the washing water in the liquid reservoir in the succeeding-stage water washing section can be lower than the concentration of the amine compound in the washing water in the liquid reservoir in the preceding-stage water washing section. That is, washing water is withdrawn from the liquid reservoir in the water washing section in the succeeding stage and supplied to the liquid reservoir in the water washing section in the preceding stage for dilution of the washing water in the liquid reservoir, whereby the concentration of the amine compound in the washing water in the preceding-stage water washing section can be decreased. As such, the amount of recovery of the amine compound in the preceding-stage water washing section, which roughly collects the amine compound, is increased, and the amount of the amine

compound flowing into the succeeding-stage water washing section is decreased. As a result, the concentration of the amine compound in the washing water in the succeeding-stage water washing section can be kept lower. The finish-recovery in the succeeding-stage water washing section can result in the recovery of the amine compound in the decarbonated exhaust gas until lowering of its concentration to a minimum. As described above, washing water is withdrawn from the liquid reservoir in the water washing section in the succeeding stage and supplied to the liquid reservoir in the water washing section in the preceding stage. Consequently, the apparatus can produce the synergistic effect of increasing “the amount of rough collection” of the amine compound in the preceding-stage water washing section, and raising the level of “finish-treatment” of the amine compound in the succeeding-stage water washing section. This synergistic effect can achieve the treatment of the amine compound in the decarbonated exhaust gas until its concentration lowers to a minimum level. However, none of GB ‘738, JP ‘225, Fujii et al. and Thonsgaard is believed to discuss that the washing water is withdrawn from liquid reservoir of the one in the succeeding stage and supplied to the liquid reservoir of the one in the preceding stage. Thus, Claims 7, 10 and 18 are believed to be further distinguishable from GB ‘738, JP ‘225, Fujii et al. and Thonsgaard.

In view of the amendments and discussions presented above, Applicants respectfully submit that the present application is in condition for allowance, and an early action favorable to that effect is earnestly solicited.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'Gregory J. Maier', is written over a horizontal line.

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